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Kondou et al.

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(54) **POWER CORD**

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Jun. 5, 2013 (JP) 2013-118947

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H01R 13/713 (2006.01)
H01R 24/30 (2011.01)
H01R 103/00 (2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/6683*** (2013.01); ***H01R 13/7137*** (2013.01); ***H01R 24/30*** (2013.01); *H01R 2103/00* (2013.01)

(58) **Field of Classification Search**

CPC H01R 13/6683; H01R 13/7137; H01R 24/30; H01R 2103/00; H02H 5/04
USPC 361/103
See application file for complete search history.

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(57) **ABSTRACT**

A power cord includes a plug having blades configured to be inserted into blade insertion holes of an electrical outlet, respectively. The power cord further includes thermal sensors provided for the blades one each. When a temperature detected with any of the thermal sensors is higher than a prescribed temperature, electric power is stopped from being supplied to a load from the blades.

8 Claims, 10 Drawing Sheets

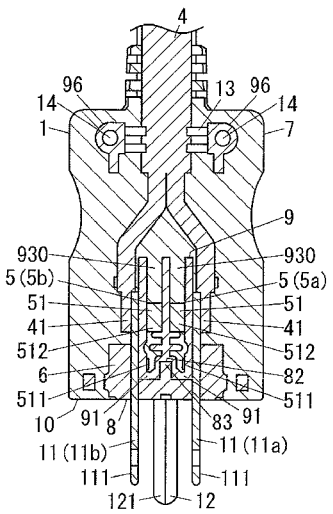


FIG. 1

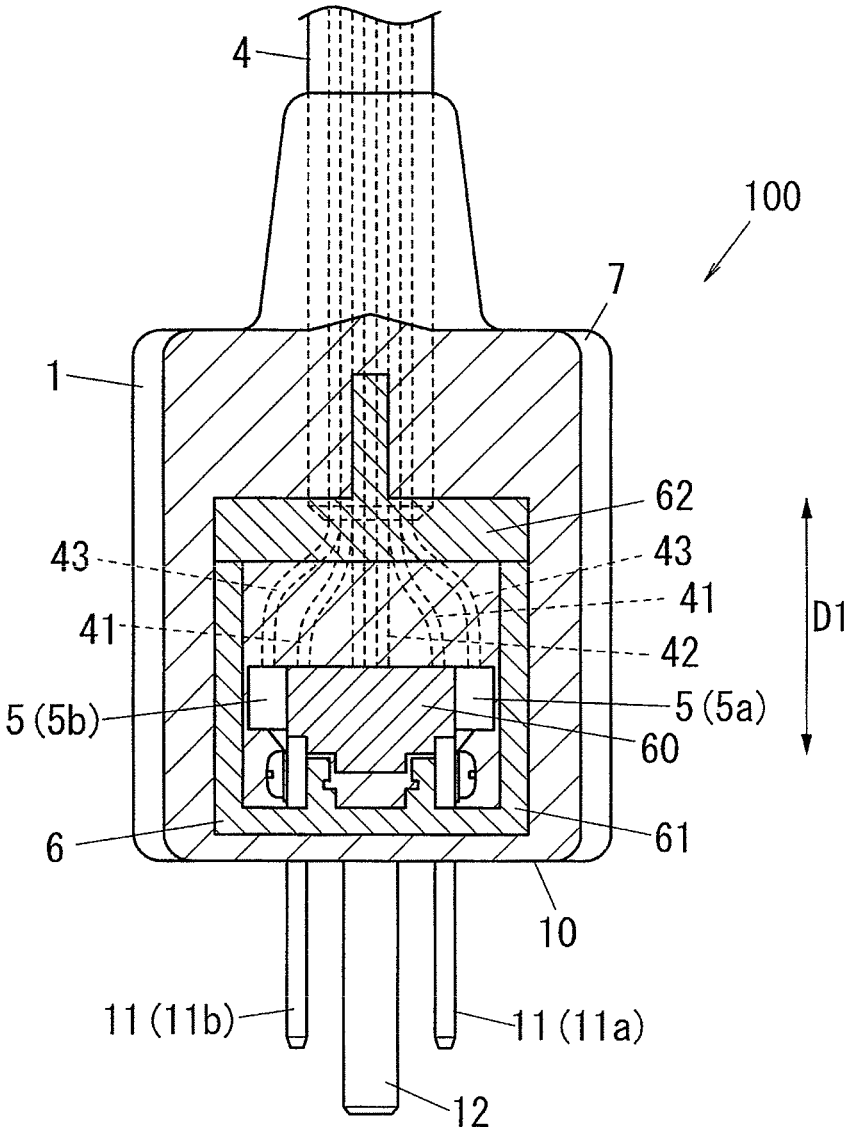


FIG. 2

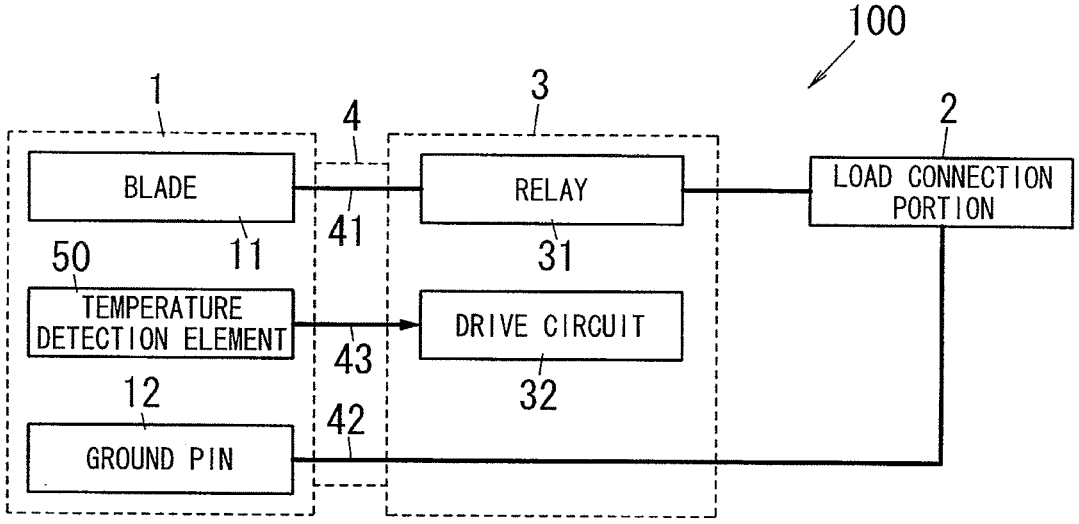
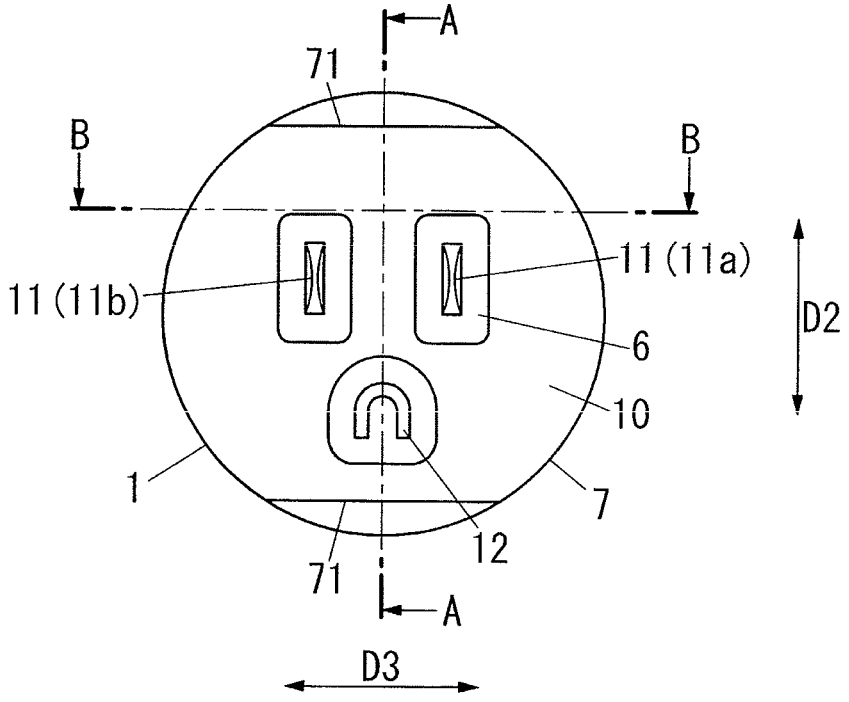

100
1
4
3
2
BLADE
41
RELAY
LOAD CONNECTION PORTION
50
11
31
TEMPERATURE DETECTION ELEMENT
43
DRIVE CIRCUIT
12
32
42
GROUND PIN

FIG. 3


A
71
B
B
11 (11a)
11 (11b)
D2
6
10
1
7
12
71
A
D3

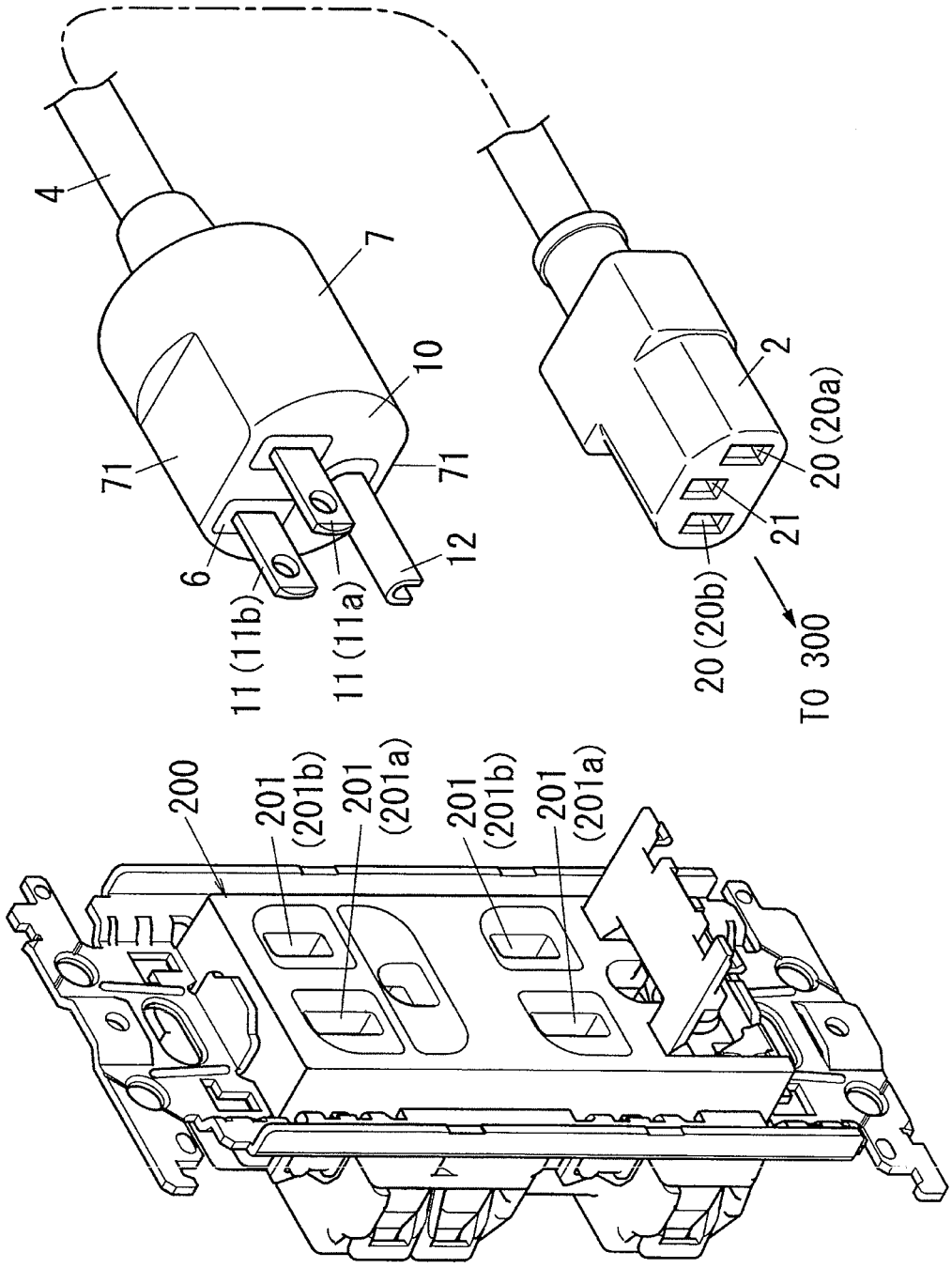

4
7
10
71
71
6
12
11 (11b)
11 (11a)
2
20 (20a)
21
20 (20b)
TO 300
200
201 (201b)
201 (201a)
201 (201b)
201 (201a)

FIG. 4

FIG. 5

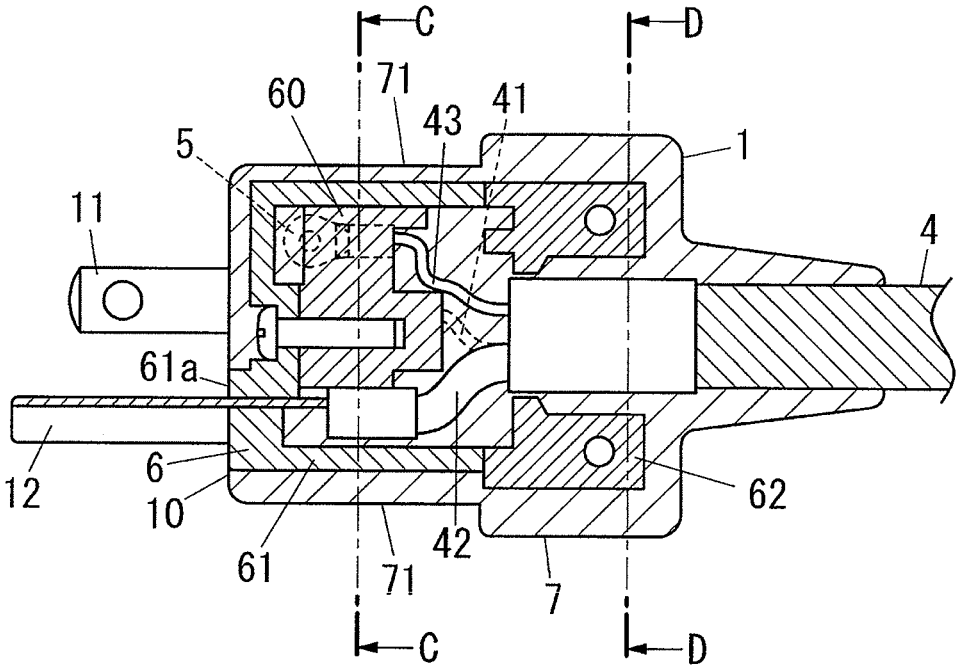

C
D
60
71
43
41
5
1
11
4
61a
12
6
10
61
71
42
7
62
C
D

FIG. 6

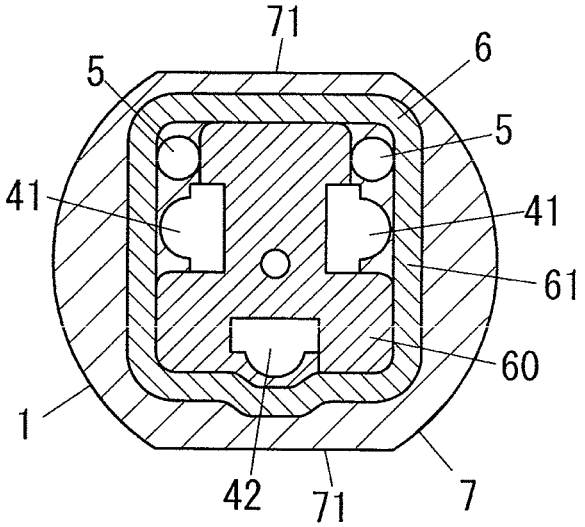

71
6
5
5
41
41
61
60
1
42
71
7

FIG. 7

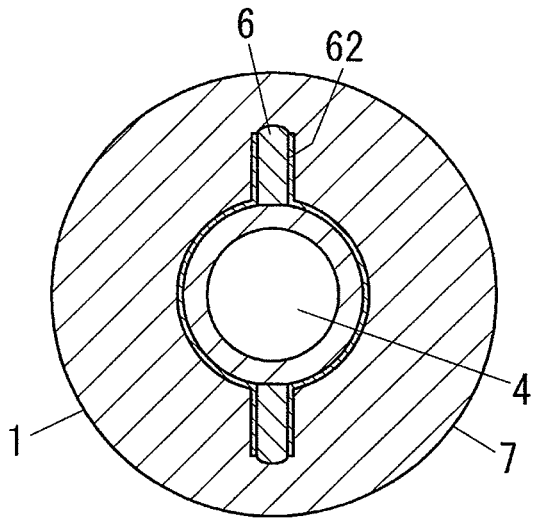


FIG. 8

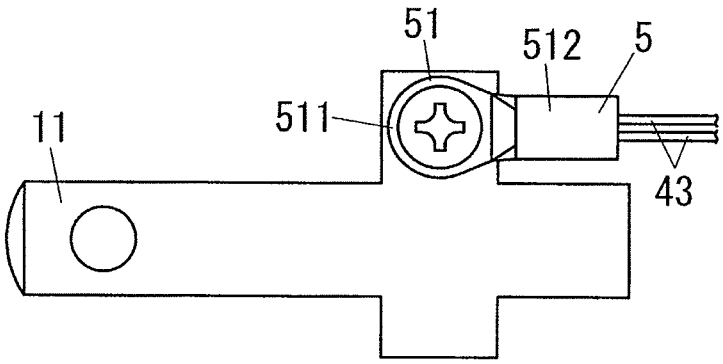


FIG. 9

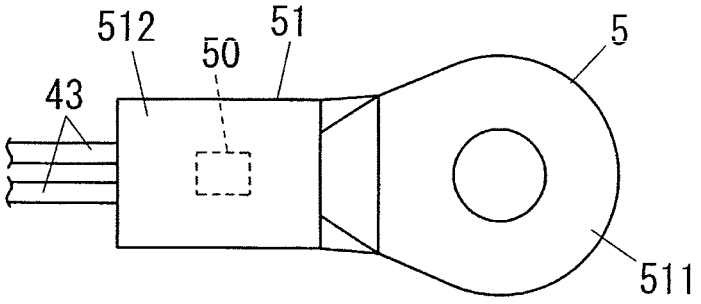


FIG. 10

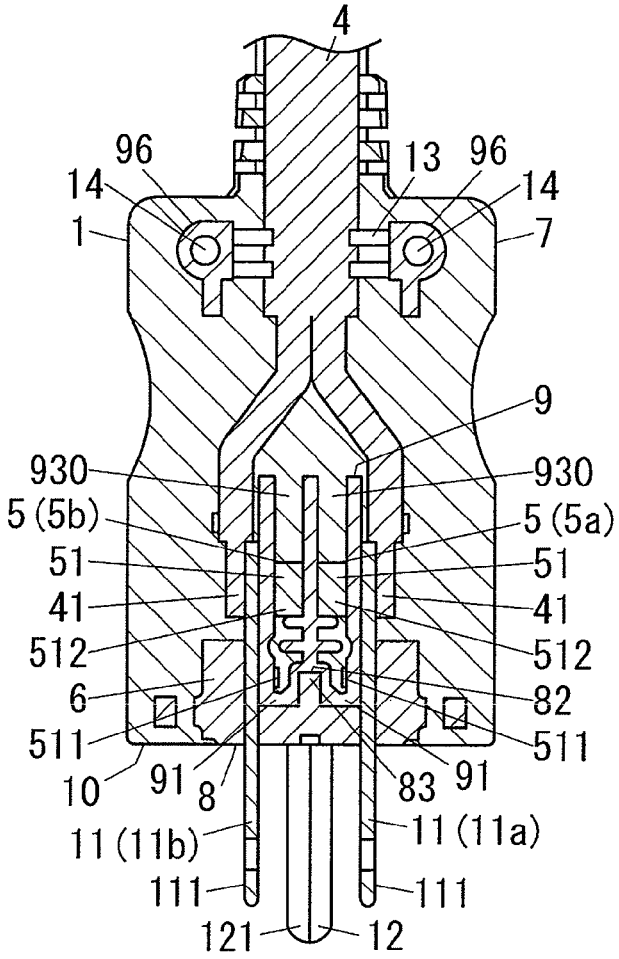
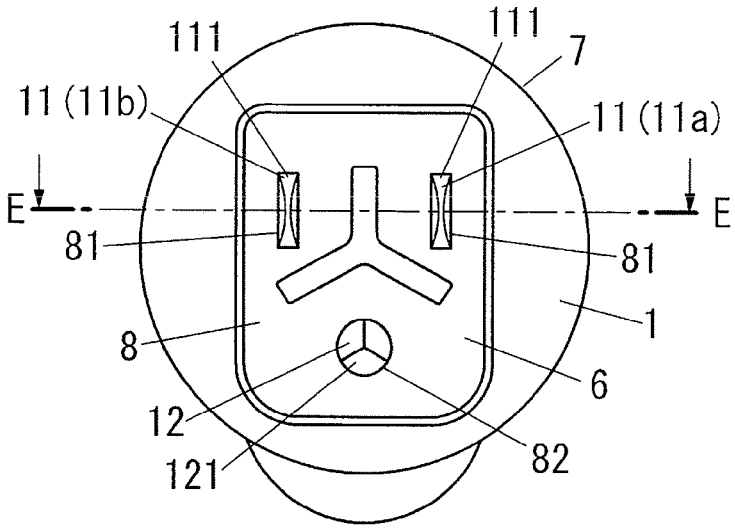

4
96
13
96
14
14
1
7
9
930
930
5 (5b)
5 (5a)
51
51
41
41
512
512
6
82
511
511
10
91
8
83
91
11 (11b)
11 (11a)
111
111
121
12

FIG. 11


111
111
7
11 (11b)
11 (11a)
E
E
81
81
1
8
6
12
82
121

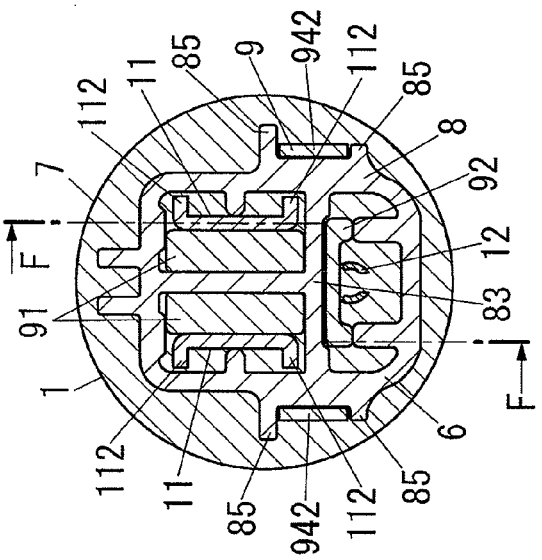


FIG. 12 C

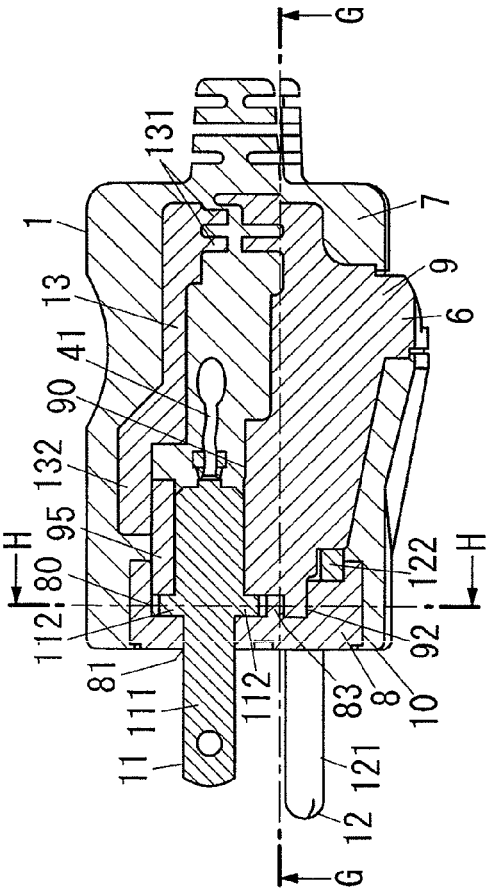


FIG. 12 A

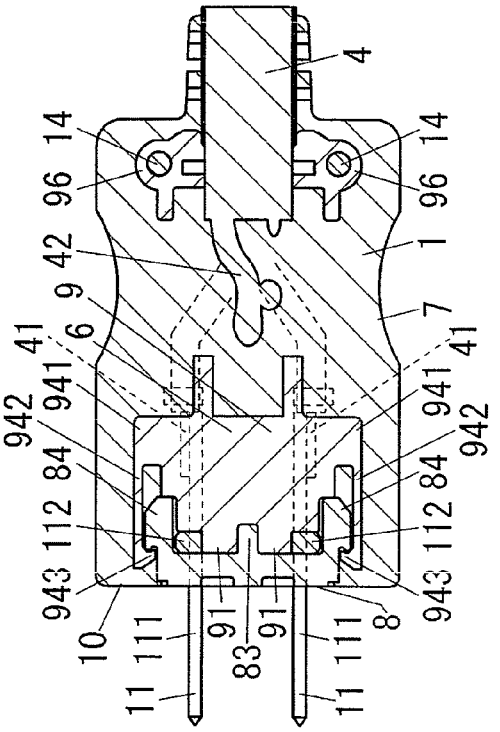
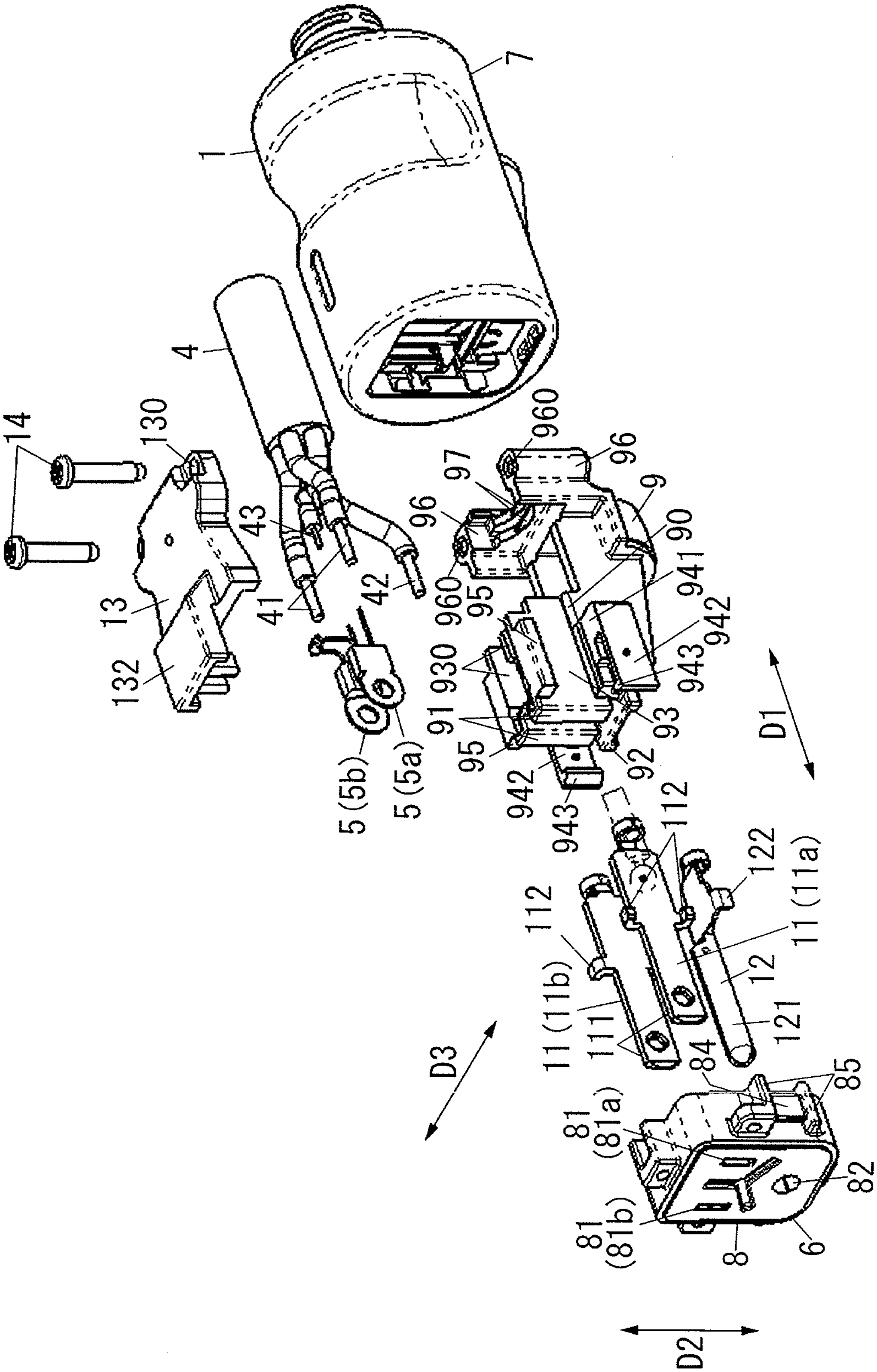


FIG. 12 B

FIG. 13



1
7
4
14
130
13
132
43
41
42
5 (5b)
5 (5a)
960
96
97
9
90
941
942
943
95
930
91
93
92
D1
112
122
11 (11a)
11 (11b)
111
12
121
84
85
81 (81a)
81 (81b)
82
8
6
D3
D2

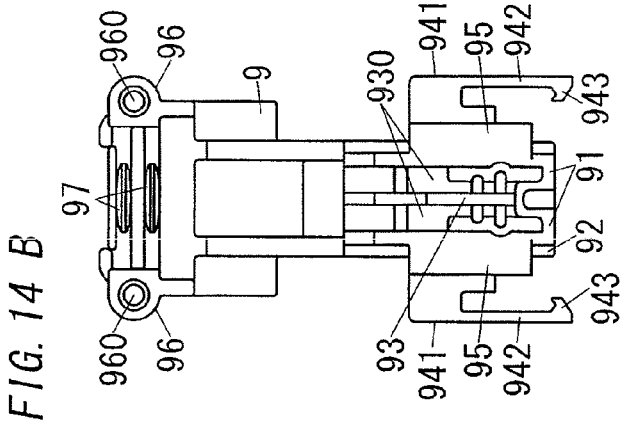


FIG. 14 B

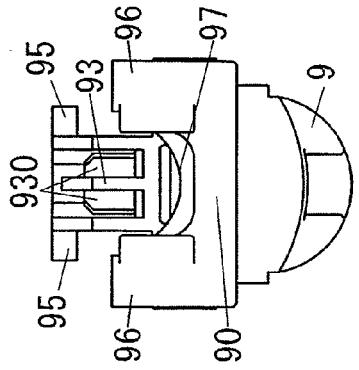


FIG. 14 D

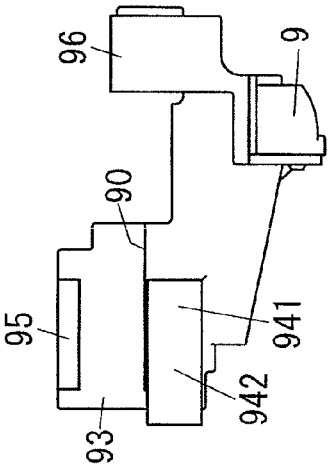


FIG. 14 C

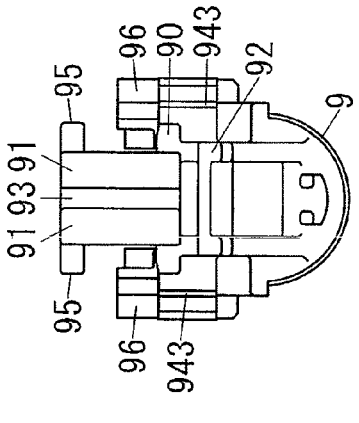


FIG. 14 A

FIG. 15

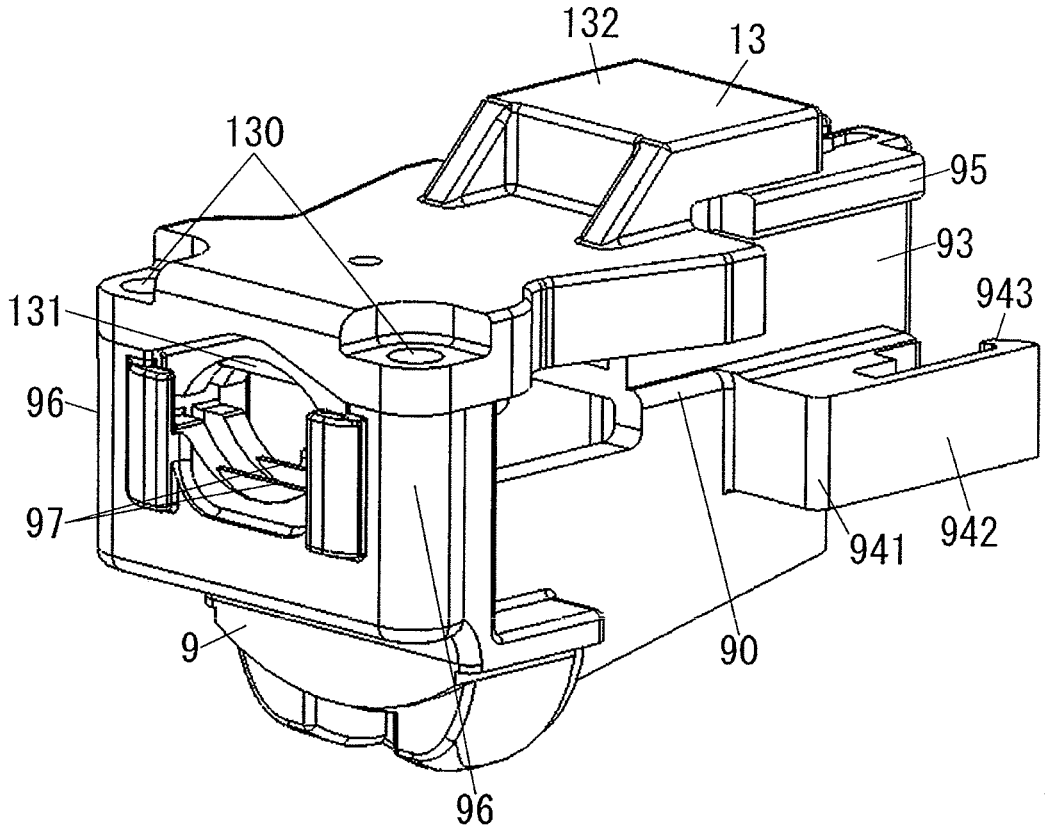
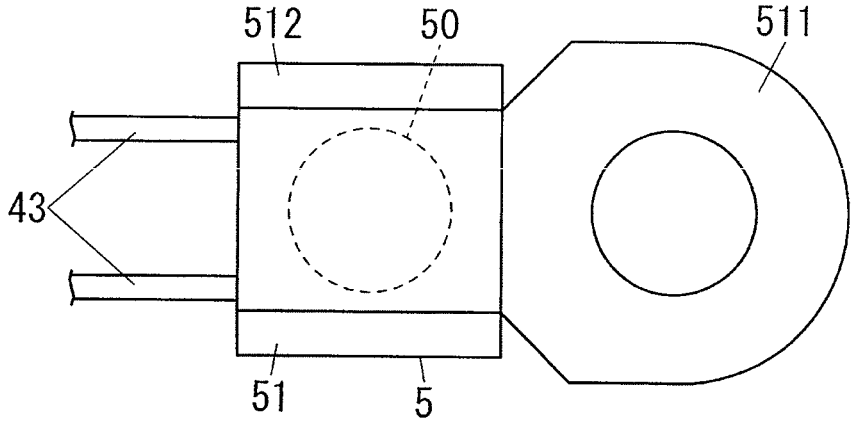


FIG. 16



POWER CORD

TECHNICAL FIELD

The invention relates to a power cord.

BACKGROUND ART

Conventionally, there is provided a power cord having a plug, a thermal sensor, and a cut-off means (for example, Japanese Patent Application Publication No. 7-67245 A). The plug is configured to be connected to an electrical outlet (or socket). The thermal sensor is configured to detect (measure) a temperature of the plug. The cut-off means is configured to stop electric power from being supplied from the plug side to a load when an abnormal rise in temperature is detected with the thermal sensor. The plug has blades configured to be inserted into the electrical outlet to come into contact with receptacle contacts in the electrical outlet, respectively.

In this sort of power cord, even in the case of abnormal heat generation due to contact failure between the electrical outlet and the blades of the plug, it is possible to protect the plug from the abnormal heat by stopping electricity feeding.

In the power cord including only one thermal sensor, there is a concern that safety is impaired by a delay in response to a temperature rise of a blade caused by a comparatively low correlation between the blade, furthest from the thermal sensor, of the blades of the plug and an output of the thermal sensor.

SUMMARY OF INVENTION

The present invention has been achieved in view of the above circumstances, and an object thereof is to provide a power cord capable of improving safety.

A power cord (**100**) of the present invention comprises a plug (**1**), a load connection portion (**2**) and a cut-off means (**3**). The plug (**1**) comprises blades (**11**) configured to be inserted into blade insertion holes (**201**) of an electrical outlet (**200**), respectively, and thermal sensors (**5**) provided for the blades (**11**) at least one each. Each of the thermal sensors (**5**) is configured to detect (measure) a temperature of a corresponding blade (**11**). The load connection portion (**2**) is configured to be connected to a load (**300**). The cut-off means (**3**) is configured to stop electric power from being supplied to a side of the load connection portion (**2**) from a side of the blades (**11**) when a temperature detected with any of the thermal sensors (**5**) is higher than a prescribed temperature.

In an embodiment, the thermal sensors (**5**) are in contact with the blades (**11**) one each.

In an embodiment, each distance between each of the thermal sensors (**5**) and a blade (**11**) corresponding thereto (**5**) is smaller than a distance between the blades (**11**).

In an embodiment, any one of the thermal sensors (**5**) is not arranged between the blades (**11**).

In an embodiment, the plug (**1**) comprises a sensor holder (**9**). The sensor holder (**9**) is made from insulating material and retains the thermal sensors (**5**) such that the sensor holder (**9**) intervenes between each of the thermal sensors (**5**) and a blade (**11**) corresponding thereto (**5**).

In the invention, it is possible to improve safety in comparison with the case where only one thermal sensor is provided.

BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments of the invention will now be described in further details. Other features and advantages of the present invention will become better understood with regard to the following detailed description and accompanying drawings where:

FIG. **1** is a sectional view of a plug in accordance with a first embodiment of the present invention, taken along line B-B of FIG. **3**;

FIG. **2** is a block diagram of the plug;

FIG. **3** is a front view of the plug;

FIG. **4** is a perspective view of a power cord in the first embodiment and an electrical outlet;

FIG. **5** is a sectional view of the plug taken along line A-A of FIG. **3**;

FIG. **6** is a sectional view of the plug taken along line C-C of FIG. **5**;

FIG. **7** is a sectional view of the plug taken along line D-D of FIG. **5**;

FIG. **8** is a side view of a blade with a thermal sensor fixed thereto, in the plug;

FIG. **9** is a side view of the thermal sensor;

FIG. **10** is a sectional view of a plug in accordance with a second embodiment of the present invention, taken along line E-E of FIG. **11**;

FIG. **11** is a front view of the plug in the second embodiment;

FIGS. **12**A to **12**C are sectional views of: the plug taken along line F-F of FIG. **12**C; the plug taken along line G-G of FIG. **12**A; and the plug taken along line H-H of FIG. **12**A, respectively;

FIG. **13** is an exploded perspective view of the plug;

FIGS. **14**A to **14**D are a front view of a sensor holder in the plug, a plan view of the sensor holder, a right side view of the sensor holder and a back view of the sensor holder, respectively;

FIG. **15** is a perspective view of the sensor holder coupled with a tension stopper; and

FIG. **16** is a side view of a thermal sensor in the second embodiment.

DESCRIPTION OF EMBODIMENTS

First Embodiment

A power cord (**100**) of the present embodiment includes a plug (a male plug) (**1**), a load connection portion (**2**) and a cut-off means (**3**). The plug (**1**) includes male connectors (**11**) and thermal sensors (**5**). The male connectors (**11**) are configured to be inserted into apertures (**201**) of an electrical outlet (**200**), respectively. The thermal sensors (**5**) are provided for the male connectors (**11**) at least one each. Each of the thermal sensors (**5**) is configured to detect (measure) a temperature of a corresponding male connector (**11**). The load connection portion (**2**) is configured to be connected to a load (**300**). The cut-off means (**3**) is configured to stop electric power from being supplied to a side of the load connection portion (**2**) from a side of the male connectors (**11**) when a temperature detected with any of the thermal sensors (**5**) is higher than a prescribed temperature.

In an example, the male connectors (**11**) are first and second male connectors (**11***a* and **11***b*), and the apertures (**201**) are first and second apertures (**201***a* and **201***b*). That is, the first and second male connectors (**11***a* and **11***b*) are configured to be inserted into the first and second apertures (**201***a* and **201***b*), respectively. In another example, the electrical outlet (**200**) further includes a ground (earth) aperture (**202**), while the plug (**1**) further includes a ground male connecter (**12**) configured to be inserted into the ground aperture (**202**).

A concrete example of the power cord (**100**) is explained. As shown in FIGS. **2** and **4**, a power cord **100** includes a plug **1**, a load connection portion **2**, and a cut-off device **3** as the cut-off means. The plug **1** is configured to be connected to an electrical outlet **200**. The load connection portion **2** is configured to be connected to a load **300**. The cut-off device **3** is configured to allow and stop electric power from being and to be supplied to the load connection portion **2** from the plug **1**.

In the embodiment, the load connection portion **2** is, for example, a connector assembly in which the cut-off device **3** is put. The connector assembly is a female plug that conforms to, but not limited to, JIS C 8303 or IEC 60320-C13 in shape, and includes first and second receptacle contacts (not shown) in the back of first and second aperture **20**(**20***a*) and **20**(**20***b*) and, as an option, a ground receptacle contact (not shown) in the back of a ground aperture **21**. The first and second receptacle contacts are electrically connected to the first and second male connectors (**11***a* and **11***b*), respectively, and the ground receptacle contact is electrically connected to the ground male connecter (**12**). In an example, the load connection portion **2** is electric wires connected to terminals (for example, screw terminal blocks) of the load **300**.

In this example, the cut-off device **3** is placed in the plug **1** or intervenes between both ends of a cable **4** to be described. Thus, the position of the cut-off device **3** is optional, and accordingly in the example of FIG. **2**, the cut-off device **3** is shown separately from the load connection portion **2**.

The plug **1** is, for example, a plug having two electrodes and a ground electrode, specified in JIS C 8303. As shown in FIGS. **3** and **4**, the plug **1** includes two blades **11** (**11***a* and **11***b*) for power supply corresponding to line (hot) and neutral, respectively, and a ground pin **12** corresponding to ground. Each of the blades **11** and the ground pin **12** is made of, for example, electrically conductive material such as metal.

The blades **11** are connected to the cut-off device **3** through power wires **41** included in the cable **4** connecting the plug **1** and the cut-off device **3**. The cut-off device **3** includes a relay **31** such as, e.g., an electromagnetic relay, configured to make or break an electrical connection between one or two of the blades **11** and the load connection portion **2**, and a drive circuit **32** configured to drive the relay **31**.

The ground pin **12** is connected to the load connection portion **2** through a ground wire **42** included in the cable **4**.

As shown in FIGS. **1**, **3** and **4**, the blades **11** and the ground pin **12** protrude from an end face **10** of the plug **1**, toward a first side of a first direction D**1** perpendicular to the end face **10** (for the purpose of simplicity, also referred to as "forward"). In addition, for the purpose of simplicity, the first side and the second side of the first direction D**1** are also referred to as a "front side" and a "back side", respectively. The blades **11** are placed at a first side of the end face **10** on a first side of a second direction D**2** perpendicular to the first direction D**1**, while the ground pin **12** is placed at a second side of the end face **10** on a second side of the second direction D**2**. For the purpose of simplicity, the first side and the second side of the second direction D**2** are also referred to as an "upside" and a "downside", respectively. In addition, first and second blades **11***a* and **11***b* as the blades **11** are arranged on first and second sides of a third direction D**3** perpendicular to the second direction D**2** (and the first direction D**1**), respectively. For the purpose of simplicity, the first side and second side of the third direction D**3** are also referred to as a "right side" and a "left side", respectively.

As shown in FIGS. **5** to **7**, the plug **1** includes a core **6** and an enclosure **7**. The core **6** is made from, e.g., an insulating material such as synthetic resin and retains the blades **11** and the ground pin **12**. The enclosure **7** is a synthetic resin molding in which the core **6** is sealed. The core **6** includes an inner frame **60**, a cover (a front cover) **61** and a cover (a back cover) **62**. The inner frame **60** retains the blades **11** and the ground pin **12** by engaging therewith for example. The cover **61** is shaped like a cylinder having a base (a front base) **61***a* on the front side and an opening (a back opening) on the back side, and the blades **11** and the ground pin **12** are inserted into the base **61***a*. The cover **62** is joined to an end (a back end) of the cover **61** on the back side. The enclosure **7** is shaped like a cylinder with an axis parallel in the first direction D**1** (a front-back direction) as a whole. The enclosure **7** is provided, on the front side, with recesses **71** on the upside and downside.

FIG. **1** is a sectional view of the plug taken along line B-B of FIG. **3**. As shown in FIGS. **1** and **8**, two thermal sensors **5** are fixed to the blades **11** one each. That is, first and second thermal sensors **5***a* and **5***b* are fixed to the first and second blades **11***a* and **11***b*, respectively. As shown in FIG. **9**, each thermal sensor **5** is formed of a temperature detection element **50**, and a holder **51** which is made of metal and retains the temperature detection element **50**. An example of the temperature detection element **50** is a temperature-sensitive resistor (so called a thermistor) having a comparatively large change in resistance value in response to a temperature change. The holder **51** has a fixed part **511** and a body part **512**. The fixed part **511** is shaped like a ring as a whole in the same way as a known lug terminal and configured to be fixed to a corresponding blade **11** with a screw. The body part **512** houses therein the thermistor. In the thermal sensors **5***a* and **5***b* having axes parallel with the first direction D**1**, the fixed part **511** of the thermal sensor **5***a* is fixed to an outer face (a right face) of the corresponding blade **11***a*, and the body part **512** thereof (**5***a*) is placed on the back side of the fixed part **511**, while the fixed part **511** of the thermal sensor **5***b* is fixed to an outer face (a left face) of the corresponding blade **11***b*, and the body part **512** thereof (**5***b*) is placed on the back side of the fixed part **511** thereof (**5***b*). Each temperature detection element **50** of the thermal sensors **5** is connected to the drive circuit **32** of the cut-off device **3** through signal wires **43** drawn out from an end face (a back end face) of a body part **512** of its own holder **51**. Electric insulation between a holder **51** and a set of a temperature detection element **50** and signal wires **43** in each thermal sensor **5** is secured by epoxy resin (not shown) filled in the body part **512** of the holder **51**. The signal wires **43** are banded together along with the power wires **41** and the ground wire(s) **42**, which constitute the cable **4**.

The drive circuit **32** is configured to turn the relay **31** off when a temperature detected with any temperature detection element **50** of the thermal sensors **5** is higher than a prescribed temperature. The drive circuit **32** is also configured to keep the relay **31** turned on, namely to allow electric power to be supplied from the plug **1** side to the load connection portion **2** side when a temperature detected with any thermal sensor **5** is equal to or lower than the prescribed temperature. The aforementioned drive circuit **32** can be realized by known electronic circuits, and accordingly are not described in detail herein. For the purpose of simplicity, FIG. **2** shows one set of a blade **11** and a temperature detection element **50**. The relay **31** may be a single pole relay that has only one set of movable and fixed contacts

intervening between one blade **11** (one power wire **41**) and a corresponding one of the apertures **20** in the load connection portion **2**, and is configured to turn on and off power to the load connection portion **2** (namely the load **300**). Alternately, the relay **31** may be a dual pole relay that has a first set of movable and fixed contacts intervening between one blade **11** and a corresponding one of the apertures **20** in the load connection portion **2** and a second set of movable and fixed contacts intervening between another blade **11** and corresponding another aperture **20**, and is configured to turn on and off power to the load connection portion **2**. In addition, the relay **31** may further include a function like known circuit breakers, configured to interrupt (open) an electrical circuit also in the case where a fault such as electric leakage or overcurrent is detected.

In the configuration of the embodiment, it is possible to improve safety in comparison with a power cord with only one thermal sensor.

Each thermal sensor **5** has a holder **51** of which fixed part **511** is in contact with one blade **11**. Any distance between each thermal sensor **5** and a blade **11** in contact therewith (**5**) is smaller than a distance between the blades **11**. Specifically, a first distance between the first thermal sensor **5***a* and the first blade **11***a* is smaller than the distance between the blades **11**, and a second distance between the second thermal sensor **5***b* and the second blade **11***b* is smaller than the distance between the blades **11** as well. It is therefore possible to enhance correlation between each output of the thermal sensors **5** and a temperature of a corresponding blade **11** in comparison with the case where each thermal sensor **5** and a corresponding blade **11** is spaced, or the case where a distance between a thermal sensor **5** and a corresponding blade **11** is larger than a distance between the blades **11**.

Each thermal sensor **5** is fixed on an opposite face of a corresponding blade **11** from another blade **11**, and no thermal sensor **5** is present between the blades **11**. Accordingly, each output of the thermal sensors **5** has a less influence on a temperature of a blade **11** separate from a corresponding blade **11** in comparison with the case where a thermal sensor **5** is arranged between the blades **11**. As a result, each output of the thermal sensors **5** has a stronger influence on a temperature of a corresponding blade **11**. It is also possible to preferably prevent the blades **11** from short-circuiting through the thermal sensors **5** in comparison with the case where a(the) thermal sensor(s) **5** is(are) arranged between the blades **11**.

Second Embodiment

Like elements are assigned the same reference numerals as depicted in the first embodiment, and not described in detail herein.

As shown in FIGS. **10** to **13**, a core **6** in the present embodiment includes: a body **8** into which blades **11** and a ground pin **12** are inserted; and a sensor holder **9** which is joined to the body **8** and retains two thermal sensors **5**. Each of the body **8** and the sensor holder **9** is made from, for example, synthetic resin. The body **8** is covered with an enclosure **7** so that a face (a front face) of the body **8** on a front side (a first side of a first direction D**1**) is exposed and flush with an end face **10** of a plug **1**.

The blades **11** are arranged so that each thickness direction thereof (**11**) is parallel with a third direction (a crosswise direction) D**3**. Each of the blades **11** has a flat protrusion **111** which protrudes from the end face **10** of the core **6** (the body **8**) forward (toward the first side of the first direction D**1**), and is configured to come into contact with a receptacle contact, corresponding line (hot) or neutral, in an electrical outlet (see **200** in FIG. **4**) as a connection target. As shown in FIGS. **12**A and **13**, each blade **11** has two retainers **112** which protrude therefrom (**11**) further than the protrusion **111** in a second direction D**2** (a vertical direction).

The ground pin **12** has a protrusion **121** which is shaped like a cylinder having an axis parallel with the first direction D**1** and protrudes forward from the end face **10** of the plug **1**. The ground pin **12** is configured so that the protrusion **121** comes into contact with a receptacle contact (not shown), corresponding to ground (earth), in the electrical outlet **200** as a connection target. The ground pin **12** further includes two retainers **122** which protrude therefrom (**12**) further than the protrusion **121** in the third direction D**3** (the crosswise direction).

The body **8** is provided with a depression **80** on a back side (a second side of the first direction D**1**). Part of each blade **11** and part of the ground pin **12** are put in the depression **80**. A bottom of the depression **80** is provided with: first and second through holes **81**(**81***a*) and **81**(**81***b*) into which the protrusions **111** of first and second blades **11***a* and **11***b* as the blades **11** are inserted, respectively; and a ground through hole **82** into which the protrusion **121** of the ground pin **12** is inserted. Each through hole **81** is shaped so that a corresponding protrusion **111** can be inserted thereinto (**81**) but a corresponding retainer **112** cannot be inserted thereinto. The ground through hole **82** is shaped so that a corresponding protrusion **121** can be inserted thereinto (**82**) but a corresponding retainer **122** cannot be inserted thereinto. The through holes **81** are arranged along the third direction D**3** on an upside (a first side of the second direction D**2**), while the through hole **82** is placed on a downside (a second side of the second direction D**2**) below an intermediate of the through holes **81**.

The body **8** is also provided with a T-shaped partition wall **83** which is protruded from the bottom of the depression **80** backward (toward the second side of the first direction D**1**), and separates a blade **11** from another while separating the blades **11** from the ground pin **12**.

As shown in FIGS. **14**A to **14**D, the sensor holder **9** includes a main body **90**, a wall **93** and two pinching parts **95**. The main body **90** is placed on a downside of the blades **11**. The wall **93** is protruded from the main body **90** upward (toward the first side of the second direction D**2**) to intervene between the blades **11**. The pinching parts **95** are protruded from an end face (an upper end face) of the wall **93** toward both sides of the third direction D**3** to individually pinch the blades **11**. Specifically, the wall **93** is shaped to have the end face (the upper end face) shaped like a "W" (see FIG. **14**B), and the pinching parts **95** are protruded from outer parts of the wall **93**.

The sensor holder **9** is provided with two first projections (first bends) **91** and a second projection (second bend) **92** on an end (a front end) thereof (**9**) on the front side. Each first projection **91** is inserted into the depression **80** to intervene between a corresponding blade **11** and the partition wall **83**. The second projection **92** is inserted into the depression **80** to intervene between the ground pin **12** and the partition wall **83**. The partition wall **83** intervenes between each two adjacent projections of the first projections **91** and the second projection **92**, thereby positioning the body **8** and the sensor holder **9** with respect to each other.

The sensor holder **9** further includes two spring saddles **941** and two spring pieces **942**. The spring saddles **941** are protruded from around a front side of the main body **90** toward both sides of the third direction D**3**. The spring

pieces **942** are each protruded forward from the spring saddles **941**. Each spring piece **942** is shaped like a flat rectangle of which thickness direction is parallel with the third direction D**3**, and each tip end side of the spring pieces **942** is free to bend in the third direction D**3**. Each spring piece **942** is provided with an engagement nail **943** on its own tip end, which protrudes from its own inner face in the third direction D**3**. The body **8** is provided with two engagement protrusions **84** protruding from two outer faces thereof (**8**). The body **8** is pinched between the spring pieces **942** in the third direction D**3**, and the engagement nails **943** each engage with the engagement protrusions **84**. That is, each engagement nail **943** comes into contact with a front side of a corresponding engagement protrusion **84**. As a result, the body **8** and the sensor holder **9** are joined together. Each engagement protrusion **84** is provided with an inclined plane on an end (a back end) thereof (**84**) on the back side, and the inclined plane becomes gradually smaller in protrusion length backward. Each engagement nail **943** is provided with an inclined plane on its own end (front end) on the front side, and the inclined plane thereof (**943**) becomes gradually smaller in protrusion length forward. In order to join the body **8** and the sensor holder **9** together, the body **8** is first pressed between the spring pieces **942** from positions where the body **8** and the sensor holder **9** are apart from each other in one direction (the first direction D**1**) with the engagement protrusions **84** aligned with the respective engagement nails **943** in the one direction (D**1**). The inclined planes of the engagement protrusions **84** and the inclined planes of the engagement nails **943** then slide on each other, while the spring pieces **942** are deformed elastically. When the engagement protrusions **84** reaches the front sides of the engagement protrusions **84**, the spring pieces **942** elastically return to the original positions thereof and the engagement nails **943** engage with the engagement protrusions **84**. The body **8** is further provided with two pinching parts **85** protruding from the two outer faces thereof in the third direction D**3**. Two pinching parts **85** on each outer face are formed so that a corresponding spring piece **942** of the sensor holder **9** is pinched therebetween (**85**) from both sides in the second direction D**2**.

A cable **4** includes part parallel with the first direction D**1** and is drawn out from the core **6** (the sensor holder **9**) backward. The sensor holder **9** is provided with two screwed parts **96** which protrudes upward from an end (a back end) of the main body **90** on the back side so that the cable **4** intervenes between the screwed parts **96** arranged at both sides of the third direction D**3** (i.e., a diameter direction of the cable **4**).

The plug **1** further includes a tension stopper **13** which pinches the cable **4** along with the core **6** (the sensor holder **9**). The tension stopper **13** is housed and retained in the enclosure **7** along with the core **6** (the body **8** and the sensor holder **9**) and the like by insert molding. The tension stopper **13** is made from synthetic resin for example. Each screwed part **96** of the sensor holder **9** has a tapped hole **960** forming an opening on its own (**96**) end face (upper end face). The tension stopper **13** is provided with two insertion holes **130** corresponding to the tapped holes **960**. The tension stopper **13** is fixed to the sensor holder **9** with two screws **14** inserted into the insertion holes **130** to be screwed into the tapped holes **960**.

The sensor holder **9** further includes ribs (linear projections) **97** which protrude upward from between the screwed parts **96**. The tension stopper **13** further includes ribs (linear projections) **131** which protrude from a face (a lower face) of thereof (**13**) on the downside toward the second side of the second direction D**2** (downward). A distance between the ribs **97** and the ribs **131** with the tension stopper **13** joined to the sensor holder **9** is smaller than an outer diameter of the cable **14** in undeformed state. That is, the ribs **97** and the ribs **131** bite the cable **4**, thereby preventing a positional displacement of the cable **4** with respect to the core **6** (especially, the sensor holder **9**).

In a manufacturing process before the enclosure **7** is formed by the insert molding, inner faces of the through holes **81** and **82** prohibit the blades **11** and ground pin **12** from being displaced in the second and third directions D**2** and D**3** with respect to the core **6**. In addition, each through hole **81** of the body **8** is shaped and sized such that retainers **112** of a corresponding blade **11** are prohibited from passing therethrough (**81**). Similarly, the through hole **82** is shaped and sized such that retainers **122** of the ground pin **12** are prohibited from passing therethrough (**82**). Therefore, the retainers **112** and **122** come into contact with the bottom of the depression **80** of the body **8**, thereby prohibiting the blades **11** and the ground pin **12** from displacing forward (toward their projecting direction) with respect to the core **6**. The sensor holder **9** is placed at the back side of (just behind) the retainers **112** and **122** of the blades **11** and the ground pin **12**. Therefore, the sensor holder **9** comes into contact with the retainers **112** and **122**, thereby prohibiting the blades **11** and the ground pin **12** from being displaced backward with respect to the core **6**.

The wall **93** of the sensor holder **9** includes two sensor storing recesses **930** each of which opens upward and backward. The two thermal sensors **5** are respectively fit into the two sensor storing recesses **930** to be retained with the sensor holder **9**. That is, an outer part of the wall **93** on a right side (a first side of the third direction D**3**) intervenes between a first thermal sensor **5***a* on the right side and the first blade **11***a*, while another outer part of the wall **93** on a left side (a second side of the third direction D**3**) intervenes between a second thermal sensor **5***b* on the left side and the second blade **11**. As shown in FIG. **15**, the tension stopper **13** includes a cover **132** covering the sensor storing recesses **930** when the tension stopper **13** is joined to the sensor holder **9**.

An external form of the plug **1** differs from that of the plug **1** in the first embodiment and an external form of each thermal sensor **5** shown in FIG. **16** also differs from that of each thermal sensor **5** in the first embodiment, but their external forms are optional, and accordingly not described in detail herein.

In the embodiment, it is possible to improve electric insulation between each set of a thermal sensor **5** (a temperature detection element **50**) and a signal wire **43** connected therewith and each set of a blade **11** and a power wire **41** connected therewith, through the sensor holder **9**.

In the manufacturing process before the enclosure **7** is formed by the insert molding, the body **8** and the sensor holder **9** are joined together by engagement. However, the present invention is not limited to this. For example, the body **8** and the sensor holder **9** may be joined together with screws in addition to engagement.

Each power wire **41** may be provided with a through hole (not shown) such that a rivet rod provided for a blade **11** or the sensor holder **9** is inserted into the through hole to be upset (deformed), thereby fixing each power wire **41** to the blade **11** or the sensor holder **9**.

In the aforementioned embodiments, each plug **11** includes, as the first and second male connectors, two blades **11** which have thickness directions parallel with the third direction D**3** and correspond to line (hot) and neutral, such

as JIS C 8303 plug, NEMA 1-15 plug, NEMA 5-15 plug or the like, but the present invention is not limited to this. For example, the plug of the present invention may include as the first and second male connectors: two blades which have thick directions parallel with the second direction D**2**, such as BS 1363 plug or the like; two blades forming a V-shape or an upside down V-shape, such as CPCS-CCC plug, AS/NZS 3112 plug or the like; or two round pins such as BS 546 plug, BS 4573 plug, CEE 7/4 plug, CEE 7/5 plug, CEE 7/16 plug, CEE 7/17 plug, 107-2-D1 plug, CEI 23-16/VII plug, SEV 1011 plug, IEC 60906-1 plug, TIS 166-2549 plug or the like.

In the aforementioned embodiments, each plug **11** further includes, as a ground male connector (option), a ground pin **12** which has a U-shape cross-section or is shaped into a hollow cylinder, but the present invention is not limited to this. For example, the plug of the present invention may include as ground connector: two ground (earth) contacts put in recesses of the plug such as CEE 7/4 plug or the like; a ground blade such as AS/NZS 3112 plug, BS 1363 plug or the like; a half round ground pin such as 107-2-D1 plug or the like; or a round ground pin such as CEI 23-16/VII plug, SEV 1011 plug, NEMA 5-15 plug, TIS 166-2549 plug or the like.

The invention claimed is:

1. A power cord, comprising:

a plug comprising an enclosure and blades configured to be inserted into blade insertion holes of an electrical outlet, respectively, and thermal sensors provided for the blades at least one each, each of the thermal sensors being configured to detect a temperature of a corresponding blade;

a load connection portion configured to be connected to a load;

a cut-off configured to stop electric power from being supplied to the load connection portion from the blades when a temperature detected with any of the thermal sensors is higher than a prescribed temperature; and

a sensor holder that is made from insulating material and retains the thermal sensors such that the sensor holder intervenes between each of the thermal sensors and a blade corresponding thereto, wherein

the sensor holder is insert molded in the enclosure, and

a wall of the sensor holder includes two sensor storing recesses.

2. The power cord of claim **1**, wherein the thermal sensors are in contact with the blades one each.

3. The power cord of claim **1**, wherein each distance between each of the thermal sensors and a blade corresponding thereto is smaller than a distance between the blades.

4. The power cord of claim **2**, wherein each distance between each of the thermal sensors and a blade corresponding thereto is smaller than a distance between the blades.

5. The power cord of claim **1**, wherein any one of the thermal sensors is not arranged between the blades.

6. The power cord of claim **2**, wherein any one of the thermal sensors is not arranged between the blades.

7. The power cord of claim **3**, wherein any one of the thermal sensors is not arranged between the blades.

8. The power cord of claim **4**, wherein any one of the thermal sensors is not arranged between the blades.

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